Syllabus of MET4750: *Techniques for Earth System Modeling* (3 credits; to be cross-listed with MET5365: *Techniques for Earth System Modeling and Research*)

**Course objectives:** This course introduces basic computational concepts and techniques for analyzing and simulating geophysical fluids including atmospheric flow and ocean currents. It teaches students how to use Python, a free/open source software, to analyze data, solve geophysical problems, and perform simple numerical simulations. Each student will complete homework assignments and a group programming project of simulating geophysical fluid system using simplified numerical models.

**Time and location:** Fall 2019, TuTh 9:30 AM – 10:45 AM AHC5-357

**Instructor:** Dr. Ping Zhu

**Office:** AHC5-234

**Office hours:** TuTh, 12:30 PM – 2:00 PM or by appointment

**Phone:** (305) 348-7096

**E-mail:** zhup@fiu.edu

**Prerequisite/Co-requisite:** MET3003, MAC2311, MAC2312

**Credit hours:** 3

**Textbook:** *Python for Scientists* by John M. STEWART,
ISBN-10: 1107686423
https://www.amazon.com/Python-Scientists-John-M-Stewart/dp/1107686423

**Grading method:** Homework & Projects (60%); Mid-term exam (20%); Final exam (20%)

**Grade scale:** A = 93-100%, A- = 90-92%, B+ = 87-89%, B = 83-86%, B- = 80-82%, C+ = 77-79%, C = 70-76%, D = 60-69%, F = 0-59%

**Course outline by weeks:**

Week 1 (Aug. 27, 29):
- Introduction to geophysical fluid system, computer science, and programming;
- Installation of Python and related libraries in laptop;
- Python basics.

Week 2 (Sept. 3, 5):
- Python flow control;
- Python list.

Week 3 (Sept. 10, 12):
- Python Numpy;
- Numpy array;
- Numpy statistics.

Week 4 (Sept. 17, 19):
- Python I/O;
- Python graphics;
- Matplotlib.

Week 5 (Sept. 24, 26):
- Pyplot 1D plots;
- Pyplot statistics.

Week 6 (Oct. 1, 3):
- Distribution; Histogram plots.
Week 7 (Oct. 8, 10):
Review and Mid-term;
Least square fitting.
Week 8 (Oct. 15, 17):
Pyplot 2D plots;
Contour plots.
Week 9 (Oct. 22, 24):
Pyplot 2D plots;
Vector and streamline plots.
Week 10 (Oct. 29, 31):
Pyplot irregular interpolation;
Python Basemap.
Week 11 (Nov. 5, 7):
Fourier transform analysis.
Week 12 (Nov. 12, 14):
Wavelet transform analysis.
Week 13 (Nov. 19, 21):
Python function;
Geophysical fluid modeling;
Poisson Equation.
Week 14 (Nov. 26):
Numerical solution of first-order ordinary differential equations;
Runge-Kutta method;
Numerical solution of 2D non-divergent barotropic vortices.
Week 15 (Dec. 3, 5):
Review;
Student presentation.

Final Exam: TBD

Learning Outcomes:
- Understand importance of computing programming in geophysical fluid studies.
- Grasp basic computing programming skills.
- Be able to design and implement programming projects
- Be able to solve simple geophysical fluid problems using Python.